Electromagnetic Field Level and 5G Roll-out
Expert Meeting
2-3 November Rome

Electromagnetic Field levels for cost-effective 5G implementation – Polish case study

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Worldwide context

By the second half of 2017 3GPP will focus on delivering the first set of standards for 5G (Release 15).

The upcoming mass sports events, the 2018 World Cup in Russia, the 2018 Winter Olympics in PyeonChang or the 2020 Summer Olympics in Tokyo, will provide an opportunity to accelerate testing and announcement of new services for these events.

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European context

Connectivity for a Competitive Digital Single Market - Toward European Gigabit Society strategic objectives:

- Strategic objective for 2025: All urban areas and all major terrestrial transport paths to have uninterrupted 5G coverage.
- Strategic objective for 2025: All European households, rural or urban, will have access to Internet connectivity offering a downlink of at least 100 Mbps, upgradable to Gigabit speed.
- Strategic objective for 2020: 5G connectivity to be available as a fully-fledged commercial service in at least one major city in each Member State, building on commercial introduction in 2018.

5G for Europe: An Action Plan objectives:

- by end of 2017 on the full set of spectrum bands (below and above 6 GHz) to be harmonized for the initial deployment of commercial 5G networks in Europe
- Work towards a recommended approach for the authorization of the specific 5G spectrum bands above 6 GHz
- Preliminary and precomercial trials
- The Commission will work with the industry and the EIB Group to identify the objectives, possible configuration, and modalities for a venture financing facility, possibly linked with other digital start-up actions.

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Polish context

In June 2017 Poland Ministry of Digital Affair signed with varius entities the **Agreement on 5G Strategy for Poland** which established cooperation between the interested parties to carry out activities leading to creation and implementation of the 5G Strategy for Poland.

Many barriers related to the development of telecommunications remain relevant. In addition, there are risks of new barriers for the development of existing networks and the introduction of new systems, including fifth generation systems.

Objectives and scope of each Team

- 5G Network Standards and Architecture Team
- Radio Spectrum Team
- Test and trials Team
- Regulatory and cooperation Team
- 5G network security Team
- 5G network promotion Team

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Wireless technology is omnipresent and expands exponentially

Future 5G networks and Internet of Things (IoT) will dramatically expand penetration of wireless devices and enforce **high infrastructure density.**

Anticipated impacts of 5G implementation:

- reduced End-to-End latency
- 10 times to 100 times higher number of connected devices
- 1000 times higher mobile data volume per geographical area.

Currently, inter-operator interconnect points are relatively sparse. In order to support a 5G service with 1 millisecond delay by achieving interconnection at every base station, there will have to happen a major change impacting the topological structure of the core network.

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Key issue

Polish exposure limit (max. Power density) for the general public for the 300 MHz - 300 GHz frequency is **0.1 W/m² (electric component - 7 V/m)**

Since ICNIRP reference levels above 10 MHz are between 2 (~27,45 V/m) and 10 W/m² (~61,4 V/m), Polish levels are from **20 to 100 times more restrictive**.

In the past, Poland used even more restrictive limits - two zones of exposure limits: temporary presence and constant presence (e.g. houses), the minimum zone limit was 0.1 W/m² and the second zone was 0.025 W/m² (3,07 V/m). Since 1998 this separation disappeared and there is only one limit of 0.1 W/m².

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Key issue

Polish exposure limit such as **0.1 W/m² (7 V/m)** may lead to the following consequences:

- Limited range of the base station grids
- The necessity to build much denser net of base stations (cost inefficient) and thus enforce increase of oversized investments costs
- Inability to share with existing technologies

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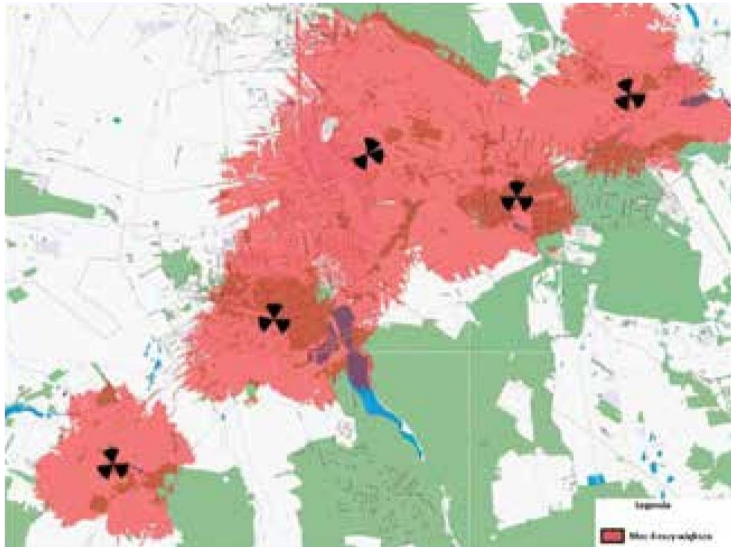
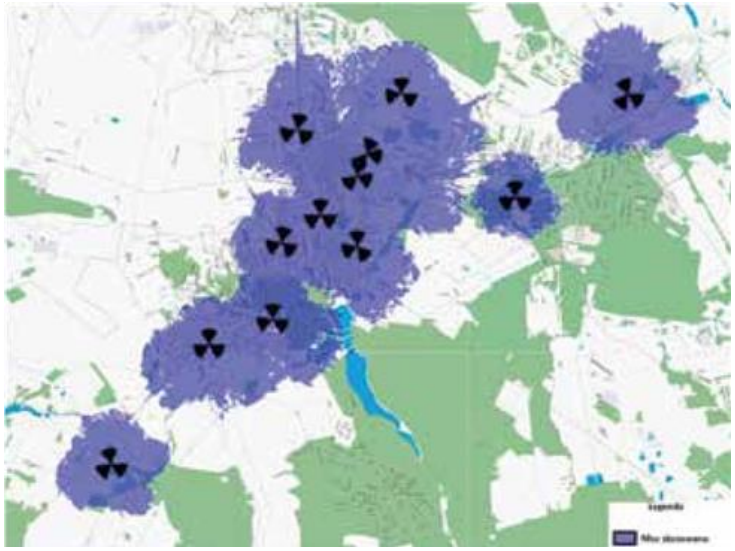
Key issue

Example of how same/larger areas can be covered with a smaller number of base stations with EC recommended EMF exposure limits (red) versus restrictive limits (purple)





Source: Arbitrary Radio Frequency exposure limits: Impact on 4G network deployment Case Studies Brussels, Italy, Lithuania, Paris and Poland, GSMA.

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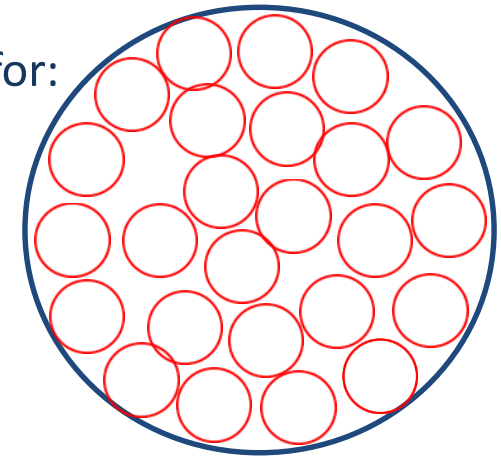
Lower exposure limits (10 W/m² vs. 0.1 W/m²) will cause the 5G cell range degradation (app. from 280 m to 56 m respectively) due to the required transmit power reduction.

Difference in the cell surface area for:

10 W/m² (70 V/m)
0.1 W/m² (7 V/m)



With a 5G radio operating in 28 GHz, in most EU countries the acceptable distance of human from the transmitter would be app. 1,1 m, while in Poland 10 times higher.

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EMF monitoring

The monitoring results carried out in all Polish regions by the Voivodship Inspectorates for Environmental Protection in 2015 show that the level of EMF in the environment in Poland is very low. The arithmetic mean of all measurements is **0.34 V/m**, which is only 4.85% of the permissible value, i.e. 7 V/m.

Area	Average arithmetic mean of EMF intensity obtained at 15 measurement points [V/m]							
	Year of monitoring							
	2008	2009	2010	2011	2012	2013	2014	2015
Central districts or urban settlements with a population exceeding 50 thousand inhabitants	0,56	0,50	0,42	0,41	0,41	0,42	0,53	0,49
Other cities	0,36	0,37	0,33	0,29	0,27	0,25	0,31	0,3
Rural area	0,3	0,31	0,27	0,19	0,2	0,19	0,18	0,21
Total	**0,41**	**0,39**	**0,34**	**0,31**	**0,29**	**0,28**	**0,34**	**0,34**

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EMF monitoring

National Institute of Telecommunications and Jagiellonian University Medical College - Report on pilot studies and analysis of permissible levels of electromagnetic fields.

Based on the results of measurements (selective, narrowband, mean square values) calculations indicate that the intensity of the electromagnetic fields at all measuring points did not exceed the value permitted by the Polish law (7 V/m) in places accessible to the population.

The authors conducted measurements with NARDA SRM-3006 for UMTS/LTE radio base stations at selected locations in Cracow and Rzeszow (cities particularly reluctant to installation of the new radiocommunication systems).

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Conclusion

The permissible exposure levels of EMF in Poland are too low to allow optimal distribution of the network across multiple frequency bands in one place.

Present regulations governing the permissible power of the electromagnetic field will slow down the development of next-generation infrastructure in comparison with other European countries.

With regard to the future deployment of the 5G network, this will become a key issue.

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Questions…

1. What are required levels of EMF for cost – effective 5G establishment in the dence/urban areas and in sparse/rural areas?
2. Incorporating the optimal EMF levels, how faster, more effective would be possible to implement 5G networks in comparsion to existing very stringent levels?
3. What needs to be done in order to convince unconvinced that there is no scientific evidence of the direct negative impact of base stations on human health?

Thank you

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